Miscellaneous

$$\%_{mass} = \left(\frac{\text{mass of element}}{\text{molar mass}}\right) \times 100\%$$

$$D = \frac{m}{v}$$

$$\text{liters (L)} = \frac{\text{milliliters (mL)}}{\text{1000 (mL/L)}}$$

$$\text{kilograms (kg)} = \frac{\text{grams (g)}}{\text{1000 (g/kg)}}$$

$$\%\text{Error} = \left(\frac{|\text{experimental value-accepted value}|}{\text{accepted value}}\right) \times 100\%$$

$$\%\text{yield} = \left(\frac{\text{actual mass of product}}{\text{predicted mass of product}}\right) \times 100\%$$

Moles

$$\text{moles (mol)} = \frac{\text{grams (g)}}{\text{molar mass (g/mol)}}$$

$$\text{grams (g)} = \text{moles (mol)} \times \text{molar mass (g/mol)}$$

$$\text{moles (mol)} = \frac{\text{liters (L)}}{\text{22.4 (L/mol)}}\ ^{*}$$

$$\text{liters (L)} = \text{moles (mol)} \times \text{22.4 (L/mol)}\ ^{*}$$

*Only Applies to gases at STP

$$\text{moles (mol)} = \frac{\text{particles (ions, atoms,etc)}}{6.02 \times 10^{23}\ \text{(particles/mol)}}$$

$$\text{particles (atoms,etc)} = \text{moles (mol)} \times (6.02 \times 10^{23}\ \text{(particles /mol)})$$

Temperature Conversion

$$C^{o} = \frac{(^{o}F - 32)}{1.8}$$

$$F^{o} = (1.8 \times ^{o}C) + 32$$

$$K = ^{o}C + 273$$

Solutions

Percent Concentration by mass

$$\%\ \text{solute} = \frac{\#\text{g solute}}{\#\text{g solution}} \times 100\% \qquad \%\ \text{solute} = \frac{\#\text{g solvent}}{(\#\text{g solution} + \#\text{g solvent})} \times 100\%$$

Molarity

$$\text{M} = \frac{\text{mol.}(\text{solute})}{\text{L}(\text{solution})} \qquad \text{M} = \frac{\left(\frac{\#\text{g}}{\text{mm}}\right)}{\text{L}(\text{solution})}$$

Molality

$$\text{m} = \frac{\text{mol.(solute)}}{\text{kg(solvent)}} \qquad \text{m} = \frac{\left(\frac{\#\text{g}}{\text{mm}}\right)}{\text{kg(solvent)}}$$

Henry's Law

$$\frac{C_1}{P_1} = \frac{C_2}{P_2}$$

Freezing Point H_2O Solutions

$$\Delta\text{T}_f = (\text{m})\left(\frac{1.86^\circ\text{C}}{1\ \text{m}}\right)(\#\text{particles})$$

$$\text{fp}_{new} = \text{fp}_{orginal} - \Delta\text{T}_f$$

Boiling Point H_2O Solutions

$$\Delta\text{T}_b = (\text{m})\left(\frac{0.51^\circ\text{C}}{1\ \text{m}}\right)(\#\text{particles})$$

$$\text{bp}_{new} = \text{bp}_{orginal} + \Delta\text{T}_b$$

pH & pOH

$$\text{pH} = -\log\left[H^+\right] \qquad \left[\text{H}^+\right] = 10^{-\text{pH}} \qquad \text{pH} + \text{pOH} = 14$$

$$\left[\text{H}^+\right]\left[\text{OH}^-\right] = 10^{-14} \qquad \text{pOH} = -\log\left[\text{OH}^-\right] \qquad \left[\text{OH}^-\right] = 10^{-\text{pOH}}$$

Titration: Stoichiometric approach:

$$(\#\text{H}^{+1})(\text{molarity}_{acid})(\text{volume}_{acid}) = (\#\text{OH}^{-1})(\text{molarity}_{base})(\text{volume}_{base})$$

Gas Law Formulas and Constants

$$\frac{(P_1V_1)}{T_1} = \frac{(P_2V_2)}{T_2}$$

$$P_1V_1 = P_2V_2$$

$$PV = nRT$$

$$\frac{V_1}{n_1} = \frac{V_2}{n_2}$$

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$PV = \frac{gRT}{MW}$$

$$d = \frac{(P)(mm)}{(R)(T)}$$

$$\frac{R_a}{R_b} = \frac{\sqrt{mw_b}}{\sqrt{mw_a}}$$

$$\text{molar mass} = \frac{(\#g)(R)(T)}{(P)(V)}$$

$$P_{gas} = P_{total} - P_{water\ vapor}$$

$$K = {}^{o}C + 273$$

Selected Universal Gas Constants (R):

$$0.082\ \frac{\text{L-atm}}{\text{mol-K}}$$

$$62.4\ \frac{\text{L-mmHg}}{\text{mol-K}}$$

$$82\ \frac{\text{mL-atm}}{\text{mol-K}}$$

$$62360\ \frac{\text{mL-mmHg}}{\text{mol-K}}$$

Standard Pressure Units:

1 atmosphere (atm)	76 cm of Hg	29.92 inches of Hg
760 mm of Hg	0.760 meters of Hg	14.7 lbs/ in^2
760 Torr	1013.25 millibars	101.33 kPa

Vapor Pressure of Water at Various Temperatures

Temp	Pressure		
(°C)	mm Hg	atm	kPa
0	4.6	0.006	0.61
5	6.5	0.009	0.87
10	9.2	0.012	1.23
15	12.8	0.017	1.70
16	13.6	0.018	1.82
17	14.5	0.019	1.94
18	15.5	0.020	2.06
19	16.5	0.022	2.20
20	17.5	0.023	2.34
21	18.6	0.025	2.49
22	19.8	0.026	2.64
23	21.1	0.028	2.81
24	22.4	0.029	2.98
25	23.8	0.031	3.17
26	25.2	0.033	3.36
27	26.7	0.035	3.56
28	28.3	0.037	3.78
29	30.0	0.040	4.00
30	31.8	0.042	4.24
31	33.7	0.044	4.49
32	35.7	0.047	4.76
33	37.7	0.050	5.03
34	39.9	0.053	5.32
35	42.2	0.056	5.62
36	44.6	0.059	5.94
37	47.1	0.062	6.28
38	49.7	0.065	6.62
39	52.4	0.069	6.99
40	55.3	0.073	7.38
45	71.9	0.095	9.58
50	92.5	0.122	12.33
55	118.0	0.1553	15.74
60	149.4	0.1965	19.92
65	187.5	0.247	25.00
70	233.7	0.308	31.16
75	289.1	0.380	38.54
80	355.1	0.467	47.34
85	433.6	0.571	57.81
90	525.8	0.692	70.09
95	633.9	0.834	84.51
100	760.0	1.00	101.33

Gas	Molecular weight(g/mol)
Hydrocarbons	
Methane, CH_4	16.044
Ethane, C_2H_6	30.070
Propane, C_3H_8	44.097
2-Metyl propan*e*	58.12
N-Butane, C_4H_{10}	58.12
Acetylene, C_2H_2	26.04
Noble gases	
Helium	4.02
Neon	20.18
Argon	39.95
Krypton	83.80
Xenon	131.30
Miscellaneous	
Water Vapor	18.02
Air	28.966
Ammonia	17.02

Gas	Molecular Weight (g/mol)
Common Gases	
Hydrogen, H_2	2.016
Deuterium	2.014
Nitrogen, N_2	28.01
Oxygen, O_2	31.99
Ozone	47.99
Fluorine	37.99
Chlorine	70.91
Products of Combustion	
Carbon Dioxide, CO_2	44.01
Carbon Monoxide, CO	28.01
Hydrogen Sulfide	34.08
Nitric Oxide, NO_2	30.01
Nitrous Oxide	44.01
Sulfur Trioxide	79.99

Symbols and Charges for Polyatomic Ions			
Symbol	Name	Symbol	Name
NO_3^{-1}	nitrate	ClO_4^{-1}	perchlorate
NO_2^{-1}	nitrite	ClO_3^{-1}	chlorate
OH^{-1}	hydroxide	ClO_2^{-1}	chlorite
CO_3^{-2}	carbonate	BO_3^{-3}	borate
PO_4^{-3}	phosphate	$B_4O_7^{-2}$	tetraborate
HCO_3^{-1}	bicarbonate	BrO_3^{-1}	bromate
SO_4^{-2}	sulfate	BrO^{-1}	hypobromite
SO_3^{-2}	sulfite	IO_3^{-1}	iodate
MnO_4^{-1}	permanganate	IO^{-1}	hypoiodite
CrO_4^{-2}	chromate	$Cr_2O_7^{-2}$	dichromate
ClO^{-1}	hypochlorite	O_2^{-2}	peroxide
CN^{-1}	cyanide	NH_2^{-1}	amide
$C_2O_4^{-2}$	oxalate	PO_3^{-3}	phosphite
$S_2O_3^{-2}$	thiosulfate	HS^{-1}	hydrogen sulfide
AsO_4^{-3}	arsenate	SeO_4^{-2}	selenate
SiO_3^{-2}	silicate	$C_4H_4O_6^{-2}$	tartrate
$H_2PO_4^{-1}$	dihydrogen phosphate		
SiF_6^{-2}	hexafluorosilicate		
Polyatomic ions with 2 names			
HSO_4^{-1}	hydrogen sulfate or bisulfate		
HSO_3^{-1}	hydrogen sulfite or bisulfite		
$HC_2O_4^{-1}$	hydrogen oxalate or bioxalate		
HPO_4^{-2}	hydrogen phosphate or biphosphate		
HCO_3^{-1}	hydrogen carbonate or bicarbonate		
Special Cases			
NH_4^{+1}	ammonium	These are positive polyatomic ions	
Hg_2^{+2}	mercurous or mercury I		
*There are 2 accepted symbols for the acetate ion.			
Acetate*	$C_2H_3O_2^{-1}$ or CH_3COO^{-1}		

Notes:

Some chemists think the mercury I charged species should be a polyatomic ion.

Fixed Charge Monatomic Ions				
Symbol	**Name**		**Symbol**	**Name**
H^{+1}	hydrogen ion_(p+)		H^{-1}	hydride
Li^{+1}	lithium ion		F^{-1}	fluoride
Na^{+1}	sodium ion l		Cl^{-1}	chloride
K^{+1}	potassium ion		Br^{-1}	bromide
Rb^{+1}	rubidium ion		I^{-1}	iodide
Cs^{+1}	cesium ion		O^{-2}	oxide
Be^{+2}	beryllium ion		S^{-2}	sulfide
Mg^{+2}	magnesium ion		Se^{-2}	selenide
Ca^{+2}	calcium ion		Te^{-2}	telluride
Sr^{+2}	strontium ion		N^{-3}	nitride
Ba^{+2}	barium ion		P^{-3}	phosphide
Ra^{+2}	radium ion		As^{-3}	arsenide
Ag^{+1}	silver ion			
Zn^{+2}	zinc ion			
Al^{+3}	aluminum ion			

Rules for assigning oxidation numbers.

1. The algebraic sum of the oxidation numbers of ALL of the atoms in a compound MUST equal zero.
2. An uncombined element (free element) has an oxidation number of zero (0).
3. A monatomic ion has an oxidation number equal to its charge.
4. Fluorine's oxidation number is –1 in all compounds.
5. Oxygen has an oxidation number of –2 in all compounds.
6. Hydrogen has an oxidation number of +1 except when combined with metals.
7. All Group 1 elements will have a +1 oxidation number.
   All Group 2 elements have a +2 oxidation number.
   Aluminum will always be +3.
8. Second element in a binary compound is assigned the oxidation number it would have if it were an ion.
9. The algebraic sum of the oxidation numbers of ALL atoms in a polyatomic ion is equal to the charge of the ion.

Solubility Curves at Standard Pressure